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THE BRINE MEASUREMENT SYSTEM (BRIMS). SECTION III. OPERATION AN--ETC(U)
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NORDA-TN-110

Naval Ocean Research and Development Activity
NSTL Station, Mississippi 39529

The Brine Measurement System (BRIMS) Section III. Operation and Maintenance Manual

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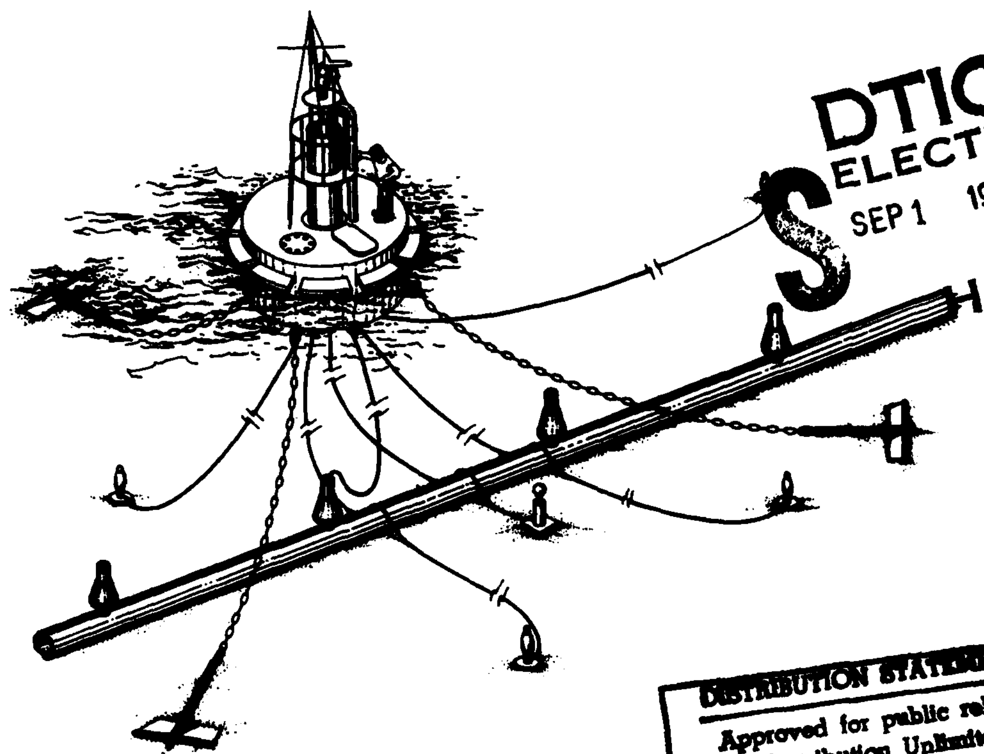

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ABSTRACT

A unique ocean measurement system that measures and analyzes highly saline brine pumped out from a salt dome, which is used for oil storage, has been developed and installed by the Naval Ocean Research and Development Activity (NORDA) under Department of Energy and National Oceanic and Atmospheric Administration sponsorship. Called the Brine Measurement System or BRIMS, the system monitors the dispersion of brine in the sea as it is evacuated from the Bryan Mound salt dome near Freeport, Texas, through a three-foot-diameter pipeline extending 12.5 miles offshore.

BRIMS has been designed to be a remote multi-sensor ocean measurement system that can provide real time data from a variety of bottom-laid and above-water sensors.

This paper addresses the operations and maintenance requirements necessary to the continuing utilization of the BRIMS.

CHANGE RECORD

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CONTENTS

1.1 Organization of Manual

The BRIMS Operation and Maintenance Manual is composed of two volumes. Volume I incorporates a broad overview of the Brine Measurement System, then goes on to elaborate on each individual system's operation and maintenance. These systems include the buoy and mooring system, in-buoy electrical/electronics system, sensor systems, and on-shore receiving and decommutating.

Volume II includes manufacturers' manuals, system drawings, calibration data, procurement documents, and cable splicing procedures. This volume (not included in this technical note) is available from the author upon request. Contact A. Sutherland, NORDA Code 350, NSTL Station, MS 39529, telephone (601) 688-4742 or FTS 494-4742.

Every effort was taken to make this manual as concise and up-to-date as possible.

1.2 BRIMS OVERVIEW

The Brine Measurement System, dubbed BRIMS, is a buoyed environmental measuring system which collects data from a variety of oceanographic and atmospheric sensors and telemeters this data to a shore based receiving site.

BRIMS was specifically designed, constructed, and installed by the Naval Ocean Research and Development Activity (NORDA) to support the Department of Energy's Strategic Petroleum Reserve (DOE/SPR) at Bryan Mound, Texas.

Salt domes, located onshore at Bryan Mound, are being evacuated of their salt contents. These domes are to be utilized as extensive natural cavities for the storage of fuel. This effort constitutes a part of the nation's Strategic Petroleum Reserve.

The salt, originally contained in the domes, is infused with fresh water and converted into a highly saline brine solution. The brine is then pumped offshore via a 14-mile pipeline to an offshore diffuser site.

The BRIMS, which is located at the diffuser site, is a significant part of an overall environmental monitoring and assessment program which is endeavoring to determine the scope and effect, if any, of the disposal of the brine on the local environment. The environmental assessment program is managed and directed by the Environmental Data and Information Service (EDIS) of the National Oceanic and Atmospheric Administration (NOAA).

BRIMS, shown in the artist's concept of the figure 1-1, consists of a large, 14-ft dia. by 7-ft high steel cylindrical buoy which has a central hawse pipe for the admission of signal cables. The buoy is moored in 70 feet of water by three chain anchor legs.

BRIMS BUOY

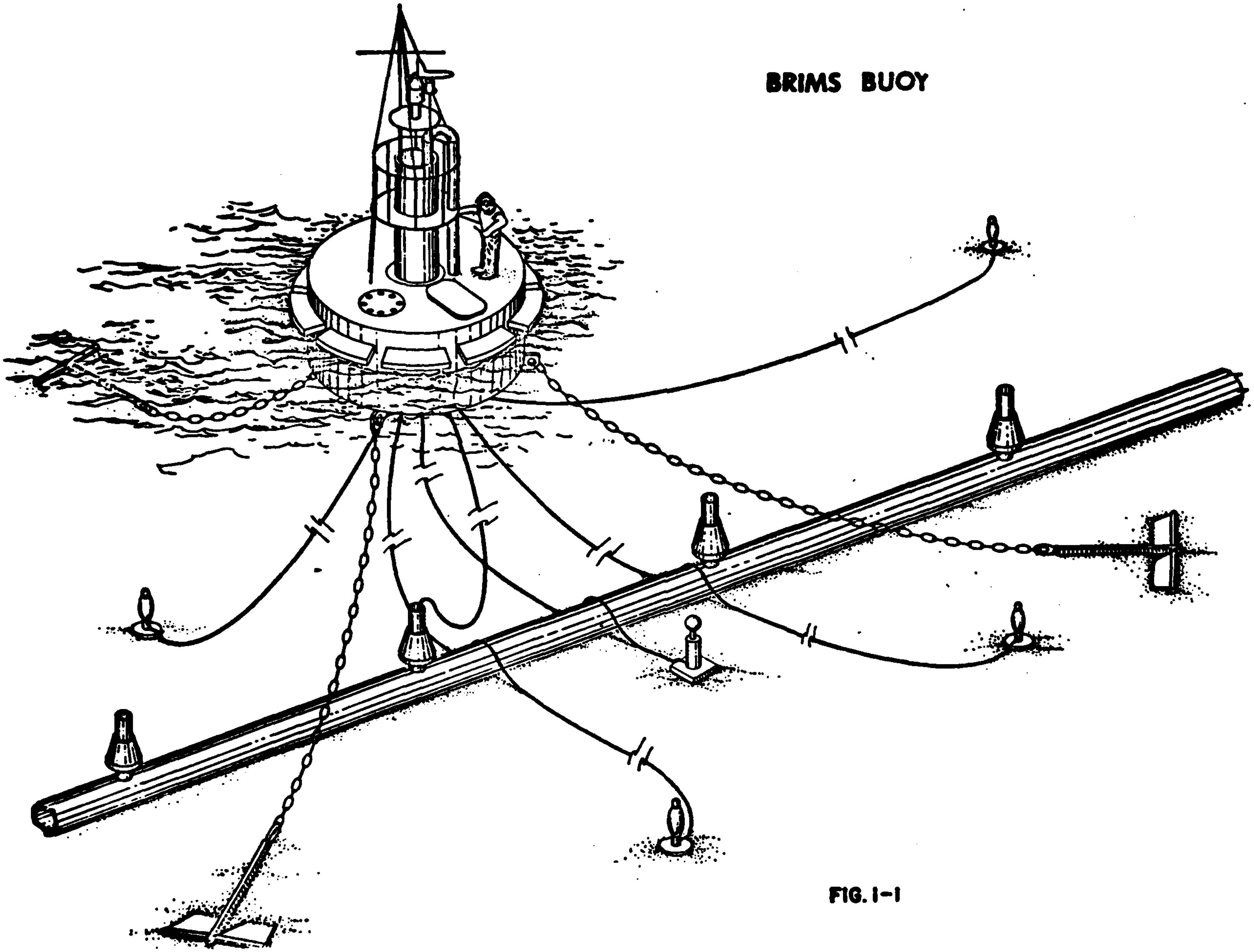

FIG. 1-1

Signals from sensors located on the seafloor are transmitted to the buoy via their respective cables. In the buoy, the analog signal data is digitized, multiplexed, and then transmitted to shore where it is demultiplexed and converted into engineering units. The data can then be stored at the shore site and also transmitted via land line to remote locations. A sample of the output of this data is shown in Figure 1-2.

The BRIMS sensor configuration consists of up to ten conductivity-temperature sensors, two currentmeters, two flow meters inserted in the brine pipeline, a wind sensor, and a barometer. The in-buoy telemetry and multiplexing system can handle up to sixty-four separate channels of data; however, further expansion ports for accepting more signal data would have to be incorporated into the in-buoy electronics system, and increased power supply capacity would be required to accomodate the addition of more data channels.

The BRIMS provides real-time output from a variety of oceanographic and atmospheric sensors and is proving to be a valuable tool for the collection of environmental data for the Strategic Petroleum Reserve.

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POS	MEASUREMENT	NAME	STATUS	UNITS	VALUE
1	CONDUCTIVITY	#1	1	MMHOS	64.1479950
2	CONDUCTIVITY	#2	1	MMHOS	63.4875946
3	CONDUCTIVITY	#3	1	MMHOS	58.2552032
4	CONDUCTIVITY	#4	1	MMHOS	58.2552032

POS	MEASUREMENT	NAME	STATUS	UNITS	VALUE
1	TEMPERATURE	#1	1	DEGREES C	29.7993774
2	TEMPERATURE	#2	1	DEGREES C	29.1268005
3	TEMPERATURE	#3	1	DEGREES C	29.1268005
4	TEMPERATURE	#4	1	DEGREES C	28.7904968

POS	MEASUREMENT	NAME	STATUS	UNITS	VALUE
1	BAROMETRIC PRESS		1	MBAR	1000.5349731
2	WIND VELOCITY		1	KNOTS	4.8746033
3	WIND DIR.		1	DEGREES	32.0339966
4	X CURRENT		1	FT/SEC	0.6019993
5	Y CURRENT		1	FT/SEC	0.2242002
6	FLOW		1	FT/SEC	7.7914410

POS	MEASUREMENT	NAME	STATUS	UNITS	VALUE
1	SALINITY NO	1	1	parts/1000	37.3156891
2	SALINITY NO	2	1	parts/1000	37.3606720
3	SALINITY NO	3	1	parts/1000	35.6211243
4	SALINITY NO	4	1	parts/1000	35.5287247

POS	MEASUREMENT	NAME	STATUS	UNITS	VALUE
1	+12 VOLTS		1	VOLTS	11.7884598
2	+28 VOLTS		1	VOLTS	26.6675644
3	PUMP		4	ON/OFF	-0.0688791
4	-12 VOLTS		4	VOLTS	-13.2466011

POS	MEASUREMENT	NAME	STATUS	UNITS	VALUE
1	Current Dir.	# 1	1	degrees	69.5733566
1	Current Spd.	# 1	1	cm/sec	19.5801411

Figure 1-2

1.2.1 Buoy and Mooring System

The mooring consists of a standard Navy, class D telephone mooring. This moor is a tri-leg mooring capable of holding 75,000 lbs of lateral force in any direction. This mooring was selected for a variety of reasons, among which were: (1) Significant precedence of longevity in the open sea (2) The buoy size permits ability to work inside the buoy and allows for significant space for batteries and electronics (3) A tri-moor with a central (hawse) pipe is essential for buoyed multi-cabled systems (4) It provides a high visibility warning to mariners of pipeline and sensor location and finally, (5) Its major components existed in Navy surplus stockpile and were readily available to the project at no cost. Total, in air, weight of all mooring components is 102,000 lbs. Figure 1-1 shows the buoy in position at the diffuser site.

1.2.1.1 Buoy

The unmodified buoy consists of a cylindrical steel structure measuring 14 ft in diameter by 7 ft high. It weights 20,500 lbs in air and has a reserve buoyancy of 49,650 lbs.

Structural modifications to the basic hull were designed by NORDA and constructed by the Naval Construction Battalion Center, Gulfport, Mississippi. The modifications to the buoy shown in Figure 1-3 and drawings in Vol. II consist of the addition of a 24" diameter, 8 ft high pipe; an 8" diameter, 10 ft high pipe with a gooseneck top; a work platform; a mounting structure for a combination foghorn and light; and a watertight deck hatch.

Sensor cables are routed up through the buoy hawsepipe, through the 24" pipe, then to the 8" gooseneck and finally down into the buoy. This routing scheme provides excellent protection against water intrusion, yet, provides a simple means for accepting more cables into the buoy. Additionally, the 8" pipe serves as an air vent which is required for ventilating the Air

BRIMS BUOY

(Cutaway View)

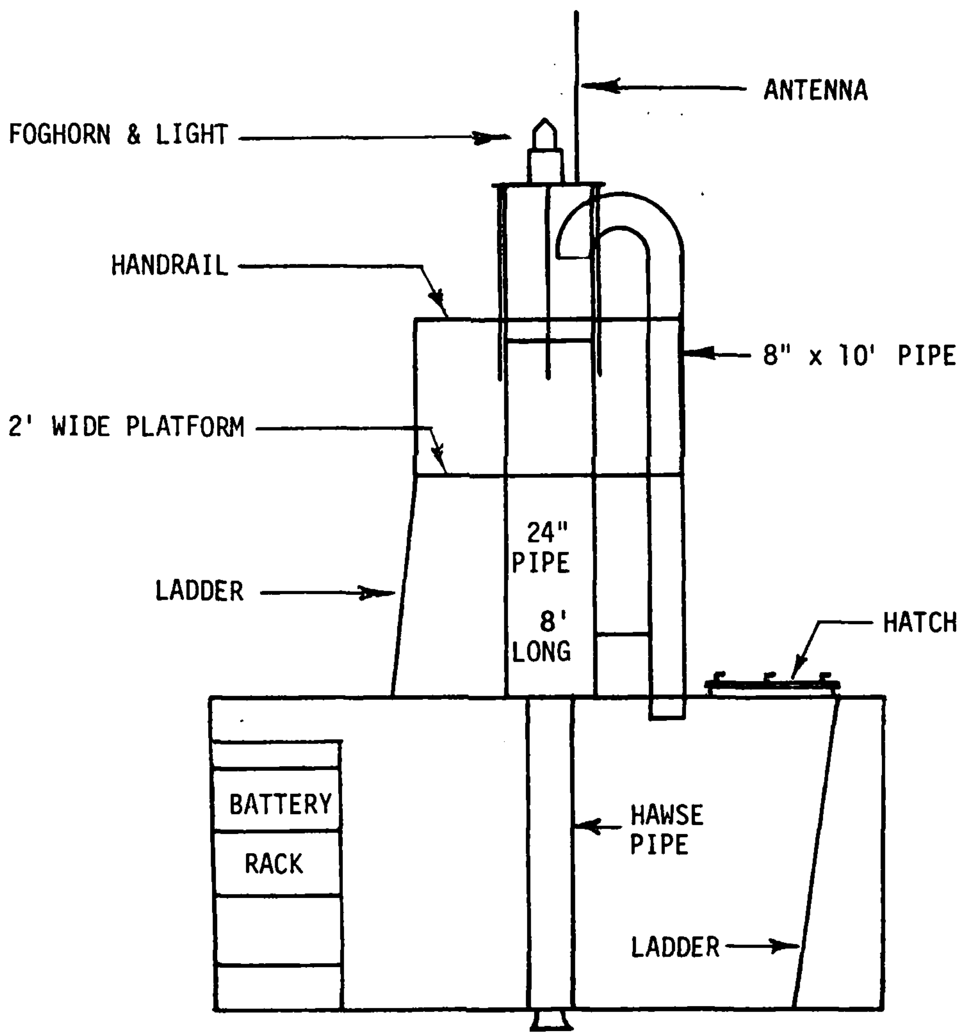


FIGURE 1-3

Battery Power System. The 24" diameter pipe serves as a protector for the sensor cables, a platform for the antenna and foghorn/light, and structural bracing for the 8" diameter pipes and work platform.

Internal buoy modifications include the addition of an access ladder, a battery rack, deck grating and plywood mounting boards for the attaching of watertight electronics packages. For structural details, the reader is referred to the systems drawings in Volume II.

1.2.1.2 Mooring Legs

The mooring legs consist of a 6,000 lb. STATO anchor with a rated maximum holding power of 120,000 lbs. The chain for each leg consists of six shots (540 ft.) of 2" chain with appropriate shackles, swivels and joining links. The related strength of the chain is 230,000 lbs., and each shot (90 ft.) weighs 3,525 lbs.

1.2.2 In-Buoy Electrical/Electronics System

This section provides general information on electrical/electronic system configuration, operating principles and model identification of individual system components. For more detailed information on the individual system components, refer to manufacturers' manuals and drawings contained in Volume II and the information on operation and maintenance contained in Section 2.2.

1.2.2.1 General

The in-buoy electrical/electronic system comprises the following major subsystems:

(1) Battery Power Subsystem

(2) Timer/Transmitter Unit

(3) PCM/Interconnection Unit

(4) Navigational Aids

(5) Bilge Pump System

These major subsystems and their associated components are connected in the system configuration shown in the block diagram of Figure 1-4. More detailed information on the function of each subsystem and component is provided in the following sections.

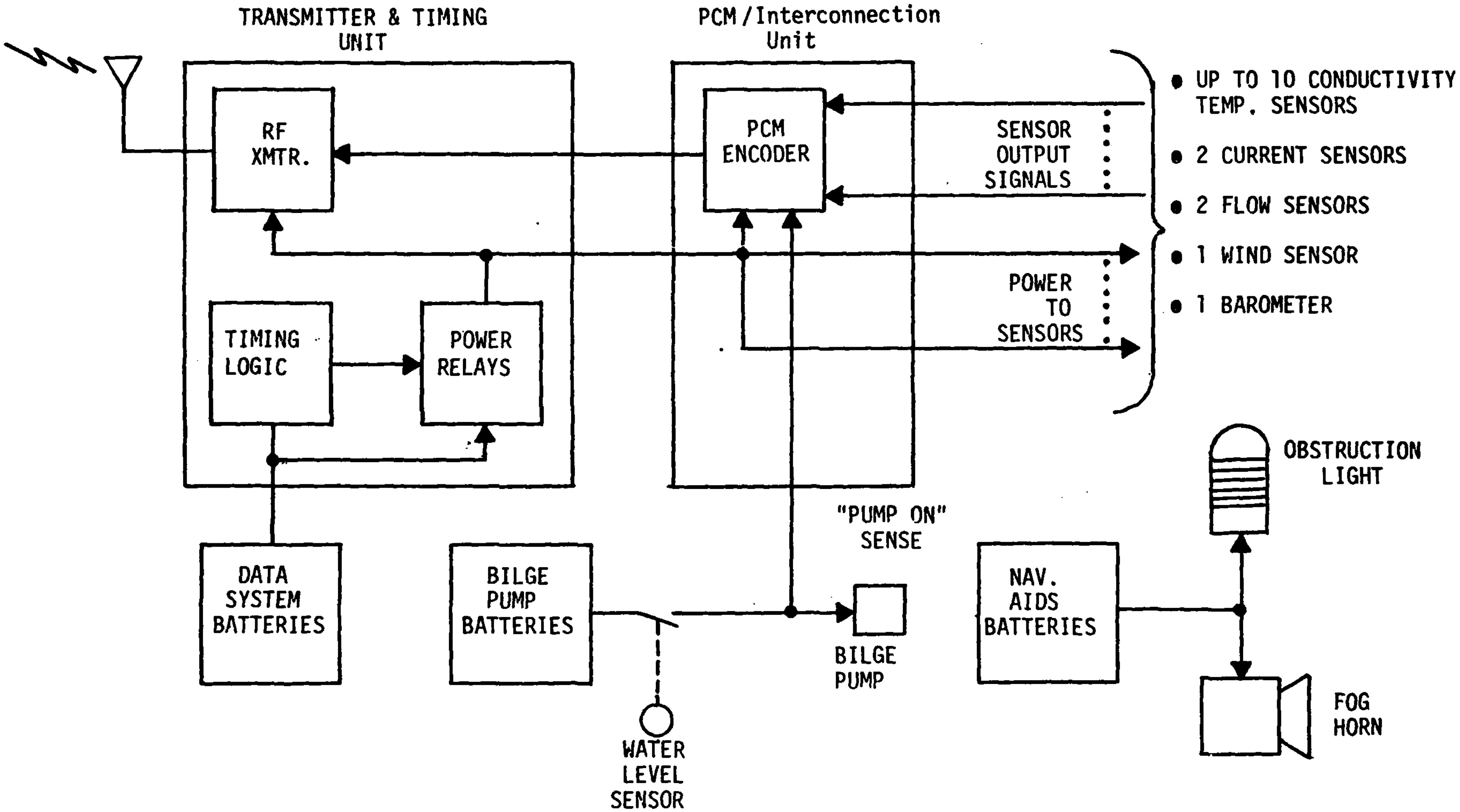
1.2.2.2 Power Subsystems

All power for the in-buoy systems is provided by battery banks consisting of the necessary number of type ST-22-1100 batteries manufactured by McGraw Edison Co., Bloomfield, NJ.

Voltages provided for in-buoy electronics systems are +28 VDC and ± 12 VDC.

Separate +12 VDC battery banks are provided for the navigational aids and the bilge pump system; and, in addition, a 12 VDC lead-acid "surge" battery is provided for the bilge pump.

Battery System interconnections are shown in Figures 1-5, 1-6, and 1-7. Also see Battery Installation, BRIMS Buoy Drawing Vol. II.

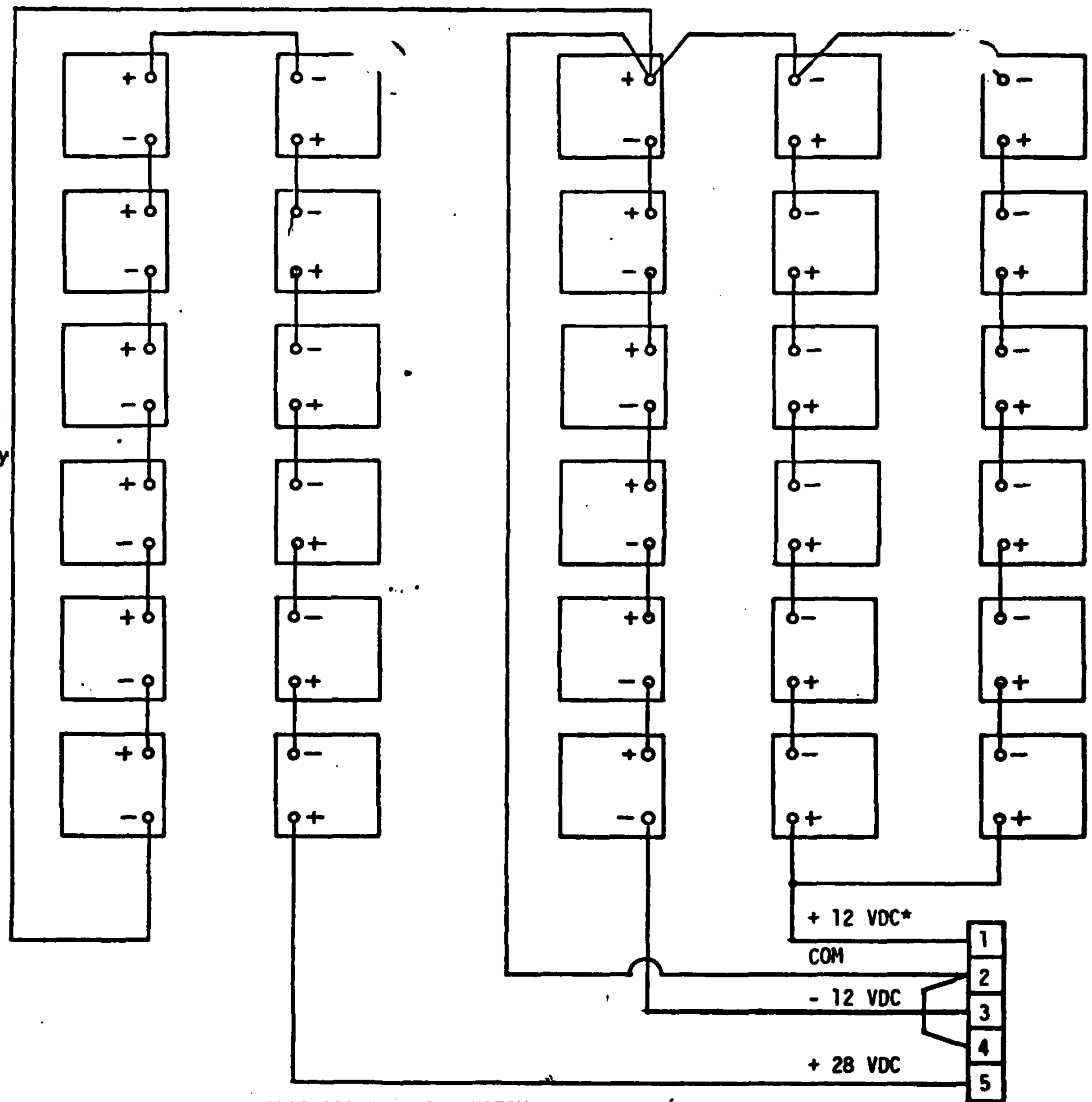


BRIMS DATA ACQUISITION AND TRANSMISSION
SYSTEM DIAGRAM

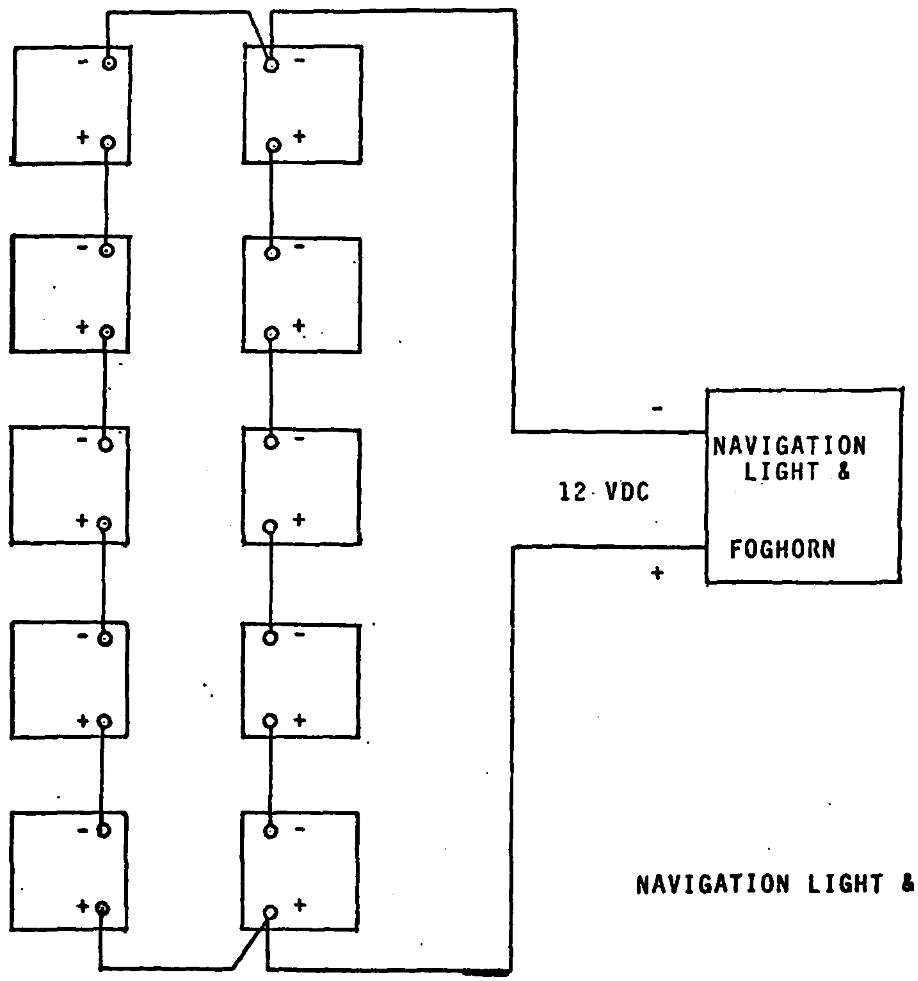
FIGURE 1-4

* +12 VDC supply consists of two series strings of ST-2 batteries connected in parallel to provide additional ampere-hour and surge current capacity

ALL BATTERIES ARE EDISON ST-22 NOMINAL VOLTAGE 2.5 VDC EACH



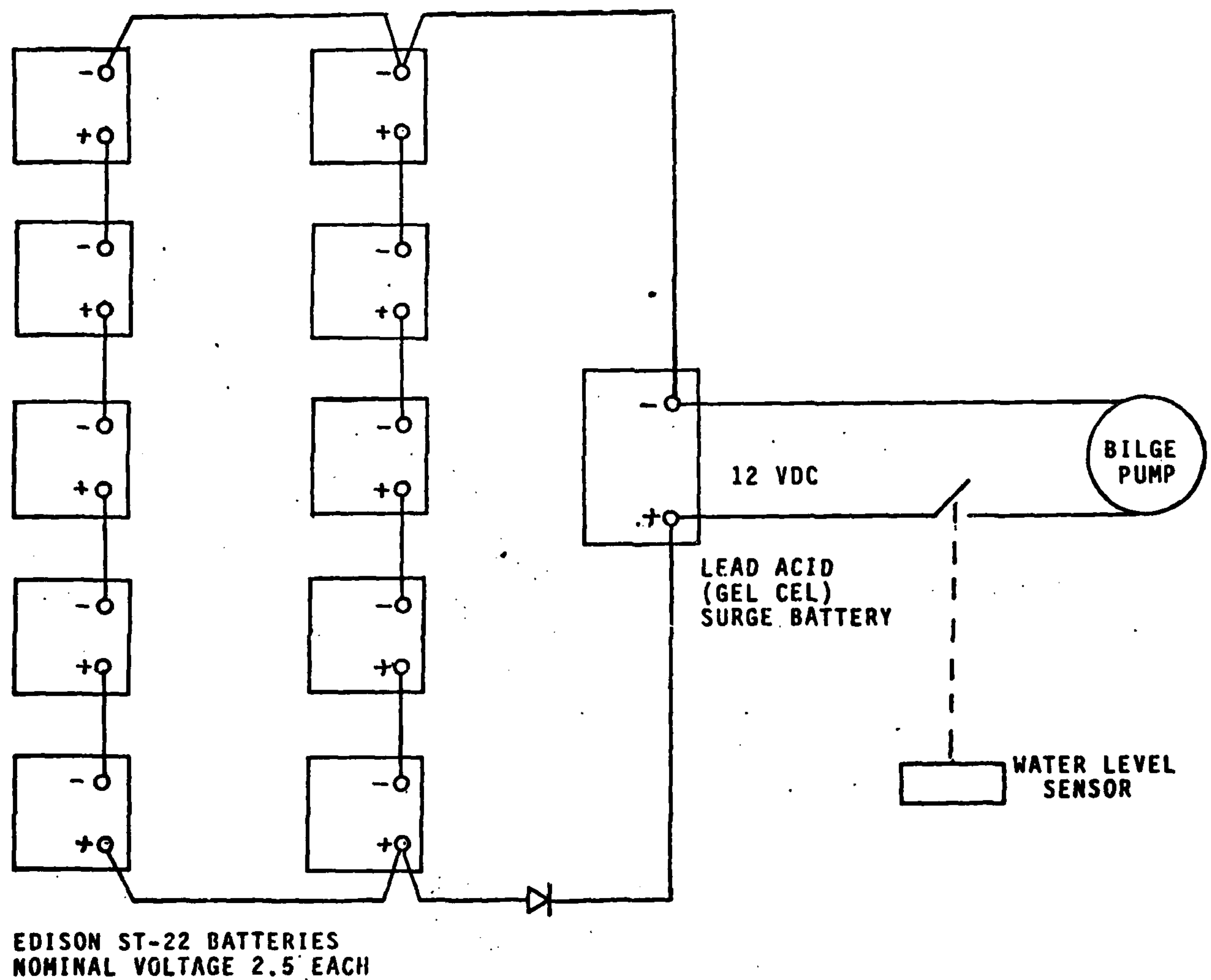
ELECTRONICS BATTERY SYSTEM
FIGURE 1-5



NAVIGATION LIGHT & FOGHORN BATTERY SYSTEM

ALL BATTERIES ARE EDISON ST-22
NOMINAL VOLTAGE 2.5 VDC EACH

FIGURE 1-6



BILGE PUMP BATTERY SYSTEM

FIGURE 1-7

1.2.2.3 Timer/Transmitter Unit

The purpose of the Timer/Transmitter Unit is to apply system power to the in-buoy electronics at preset transmission times, accept the serial PCM encoded data from the PCM encoder unit, and transmit this data via VHF RF link to the shore station for decommutating and processing.

Timing and power control signals are provided by the timing logic unit. This unit consists of two timer cards and a power relay card, all manufactured by NORDA. The timing cards produce a signal which energizes the power relay card, which in turn applies power to all other in-buoy electronics. This power application is normally for 6 minutes every 30 minutes. These times can be changed by means of two internal thumbwheel switches. (See Timing Logic Unit Instruction Manual, Volume II).

The PCM data is transmitted at 238 MHz by a Model CT405C transmitter manufactured by Conic Data Systems, San Diego, California. The transmitter output is fed to a high band ground plane antenna manufactured by Antenna Specialist, Cleveland, Ohio.

Timer/Transmitter Unit internal connections are shown in Volume II drawing.

1.2.2.4 PCM/Interconnection Unit

The purpose of the PCM/Interconnection Unit is to serve as a junction point for all outgoing sensor power and incoming sensor signals, and to multiplex and encode all sensor signals for transmission to the shore receiving station. The encoder is a Model PCM-410 manufactured by IED, a division of Conic Corporation, San Diego, California.

The PCM-410 multiplexer/encoder accepts incoming sensor signals and encodes them into a serial PCM data stream which is then routed to the Transmitter and Timing Logic Unit for modulating the RF transmitter.

Table 1 shows the sensor/PCM channel assignments presently in effect. PCM Encoder Unit Internal Connections are shown in Volume II drawing.

1.2.2.5 Navigational Aids

Buoy Navigational Aids consist of an ML-155 MaxLumina Marine lantern, a TF-3B Synchrostat Flasher/Lampchanger and an AB-26 ½-mile fog signal, all manufactured by Tidelands Signal Corporation, Houston, Texas.

The lantern/flasher is provided with a sunswitch which turns off the lamp during daylight hours, in order to conserve battery power.

The ½-mile fog signal operates continuously providing a two-second blast every 20 seconds.

1.2.2.6 Bilge Pump System

The buoy is equipped with a bilge pump system which is automatically activated by a high water sensor. When activated, the bilge pump system also provides a high level signal to one of the PCM data channels in order to provide the shore receiving station with an indication of pump operation.

Table 1

Data Parameter	PCM 410-2 Encoder Data Channel	d/pad three Data Word
Cond. 1	1	2
Temp. 1	2	3
Cond. 2	3	4
Temp 2	4	5
Cond. 3	5	6
Temp 3	6	7
Cond. 4	7	8
Temp. 4	8	9
Cond 5	9	10
Temp. 5	10	11
Cond 6	11	12
Temp. 6	12	13
Cond 7	13	14
Temp. 7	14	15
Cond. 8	15	16
Temp. 8	16	17
Cond. 9	17	18
Temp 9	18	19
Cond. 10	19	20
Temp. 10	20	21
Current 1X	21	22
Current 1Y	22	23
Current 2X	23	24
Current 2Y	24	25
Flow 1X	25	26
Flow 1Y	26	27
Flow 2X	27	28
Flow 2Y	28	29
Wind Vel.	29	30
Wind Dir.	30	31
Baro.	31	32
+28 V	32	33
+12 V	33	34
-12 V	34	35
Pump	35	36

1.2.3 Sensor Systems

This section provides general information on the basic sensor operating principles, mooring configuration, and model identification. For more detailed information on the individual sensors, the reader is referred to the manufacturers' manuals incorporated into Volume II or the information contained in Section 2.3 on operations and maintenance.

1.2.3.1 General

All BRIMS sensors, without exception, are self-contained units, with integral signal conditioning electronics that accept either +12 VDC or ±12 VDC from the system batteries and provide a linear analog output signal to the PCM Encoder Unit. Sensor output signals are either 0-2.5 VDC or ±2.5 VDC over the full range of measurement.

All underwater sensors (conductivity/temperature, current, flow) utilize a special armored cable to connect the sensor electronics to the in-buoy electronics. This cable is a double-caged armor, seven-conductor cable manufactured by United States Steel. Its configuration is shown in Figure 1-8.

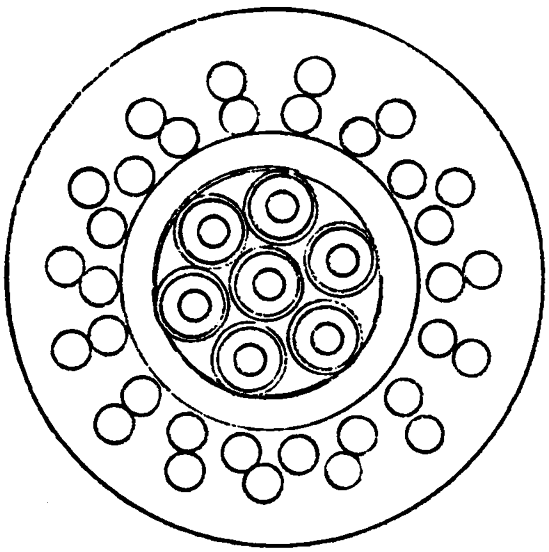
The cable combines high strength (14,000 lbs.) with extreme ease of handling for cable laying and retrieval operations as discussed in Chapter 2.3.3.1. The cable is connected to both the underwater sensor electronics and the buoy by means of an 8-pin underwater connector manufactured by Brantner and Associates, San Diego, California. This connector is attached to the sensor cable by means of the hand-splicing procedures described in Section 3.5 of Volume II.

All sensors should be calibrated before being placed into operation. New sensors should be sent to NORDA or any equally qualified group for calibration. Defective sensors which have been sent to the manufacturer for repair and which have been returned should also be calibrated before being used in the system.

REVISED
SPECIFICATIONS

Requisition D028
Conductor Cable Specifications

A 7/C CABLE, SIZE #20 AWG WITH EPC INSULATION, SEMI-CON SHEILDING AND DOUBLE-CAGES ARMOR, SUITABLE FOR MOORING OR TOWING OPERATIONS IN THE OCEAN.



(7) CONDUCTORS: #20 AWG, 7 WIRES EACH .0125" BARE COPPER WITH .028"EPC INSULATION AND .001" OF EXTRUDED SEMI-CON POLYETHYLENE SHIELDING. (CENTRAL CONDUCTOR WITH .030: INSULATION) NOM. O.D. OVER SINGLES IS .097".

ASSEMBLY: SEVEN SUCH CONDUCTORS CABLED TOGETHER WITH KNOTLESS COTTON FILLERS TO MAKE ROUND.

BINDER: SEMI-CON DACRON TAPE APPLIED WITH 50% LAP. NOMINAL O.D. .313".

CORE JACKET: BLACK, SEMI-CON TPR WITH A .040: WALL TO A DIAMETER OF .393".

INNER ARMOR: 17 WIRES EACH .051" GIPS PLUS ONE WIRE OF .335" GIPS WITH A .012" PROFYLENE COPOLYMER EXTRUSION. APPLIED SPACED AND RHL. NOM. O.D. .480".

OUTER ARMOR: 15 WIRES EACH .049" GIPS APPLIED SPACED AND LHL. NOM. O.D. .578".

SHEATH: BLACK HYTREL, PRESSURE EXTRUDED OVER AND BETWEEN ALL ARMOR WIRES TO A NOMINAL DIAMETER OF .678". WALL THICKNESS OF APEX OF OUTER WIRES IS .050".

ELECTRICALS:

D.C. CONDUCTOR RESISTANCE AT 20° C:	#20 AWG:	11.10	OHMS/K FT.
	ARMOR:	1.60	OHMS/K FT.
VOLTAGE RATING:		500	VOLTS RMS
CAPACITANCE:		45	PF/FT.

SHIELDING BY USE OF SEMI-CON EXTRUSION AND CORE JACKET IN CONTACT WITH ARMOR.

MECHANICALS:

WEIGHT IN AIR:	377	LBS./K FT.
WEIGHT IN SEA WATER: (S.G. = 1.027)	217	LBS./K FT.
BREAKING STRENGTH:	14,300	LBS./K FT.

THIS IS A TORQUE-BALANCED DESIGN.

NOTE: ALL VALUES LISTED ABOVE ARE NOMINAL.

Figure 1-8

1.2.3.2 Conductivity-Temperature Sensors

The Conductivity-Temperature (C-T) Sensor is a model CTU-8 manufactured by Montedoro-Whitney Corporation, San Louis Obispo, California. For specific ordering information, the reader is referred to the C-T purchase description contained in Volume II. The CTU-8 is a totally self-contained sensor that provides a linear analog voltage output which corresponds proportionally to the parameter being measured (conductivity and temperature). Temperature is measured by a linearized thermistor which is connected in the sensor housing to a self-balancing bridge amplifier which is used to detect the change of resistance of the thermistor.

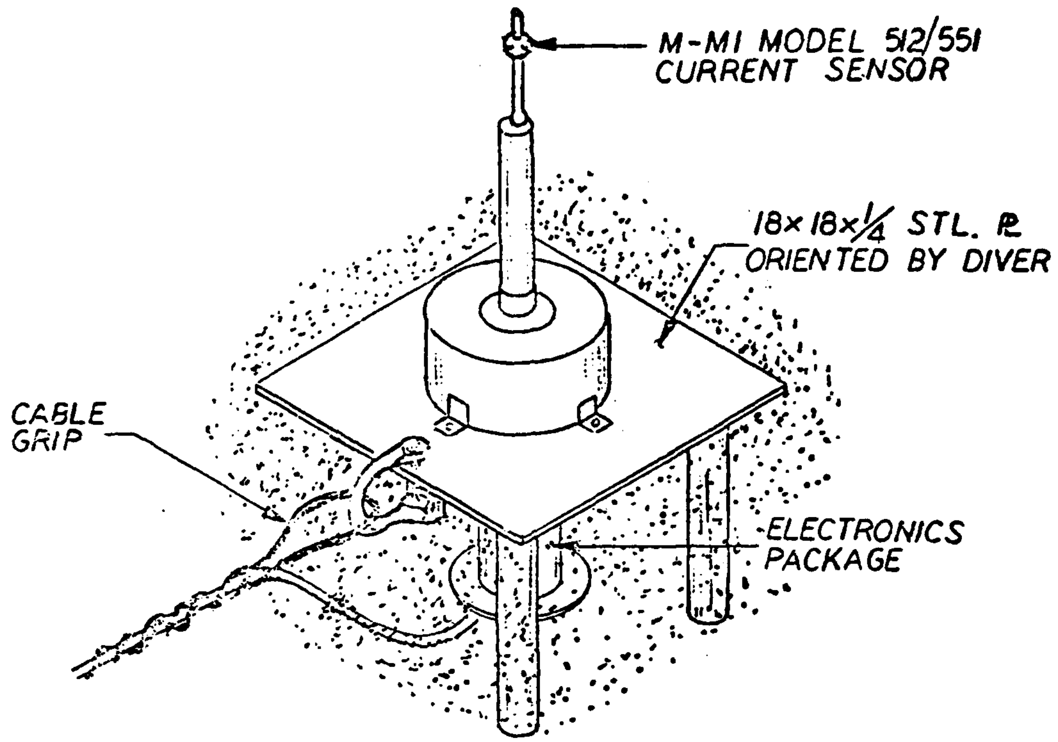
Conductivity is measured by an inductively coupled conductivity sensor, which consists of two torroidal coils placed side-by-side in the sensor unit so that they operate as a transformer. One coil is excited by a stable AC signal. This signal is coupled to the second coil by means of the water path that surrounds the outside of the sensor and passes through the hole in the sensor's center. The output level of the second coil is directly proportional to the conductivity of the surrounding water.

The sensor mooring configuration is shown in Figure 1-9 and in more detail in the systems drawings in Volume II.

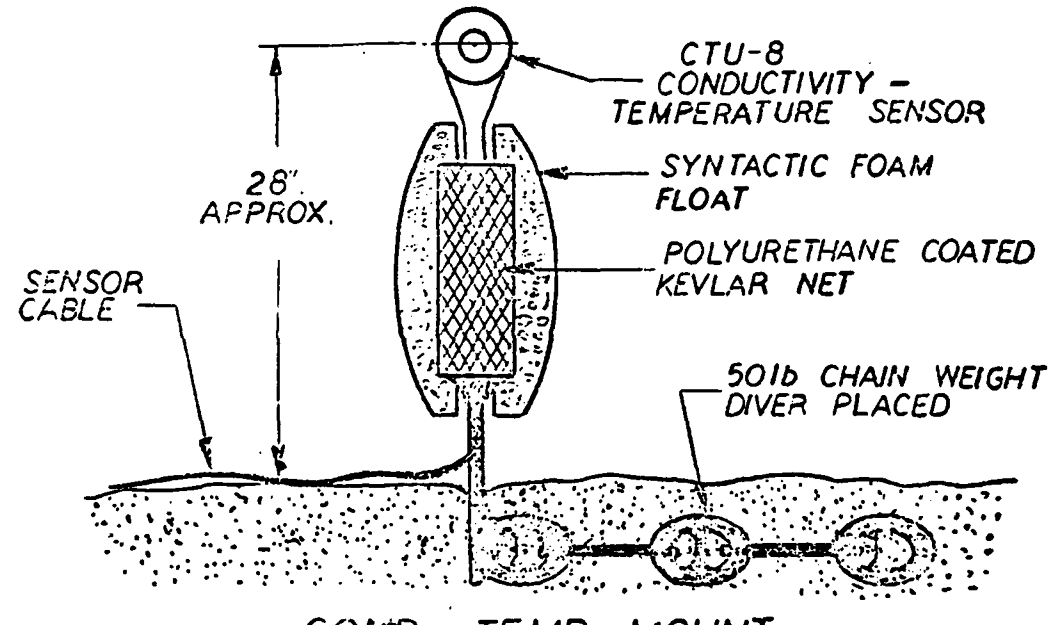
The sensor is housed in a syntactic foam buoy which floats above a chain-link mooring clump. This configuration permits self-righting of the sensor if it is in some way knocked over. The buoy protects the sensor somewhat from trawler overtopping and is smooth enough to permit passage of a trawl net over it. Practical experience has shown, however, that the sensors can get snagged by trawlers.

1.2.3.3 Current Meter

The Current Meter is a model 551 Electromagnetic Water Current meter manufactured by Marsh McBirney, Inc., Gaithersburg, Maryland. For specific ordering



CURRENT METER STAND



COND. TEMP. MOUNT

Figure 1-9

information, the reader is referred to the current meter purchase description contained in Volume II.

The principle of operation of the current meter is based on Faraday's principle of electromagnetic induction, which states that "a conductor moving in a magnetic field produces a voltage that is proportional to its velocity". In the case of this sensor, the conductor is the water; and the magnetic field is generated in the sensor head. The current meter has two sets of orthogonal probes which detect current velocity in the two orthogonal directions. These velocities can then be resolved vectorially into current direction and magnitude.

The sensor electronics are contained in an underwater housing and connected to the sensor head via a 12-foot length of cable. Incoming power and sensor output signals are routed via the armored cable as described in 1.2.3.1. The current meter sensor stand is shown in Figure 1-9 and in Volume II system drawings.

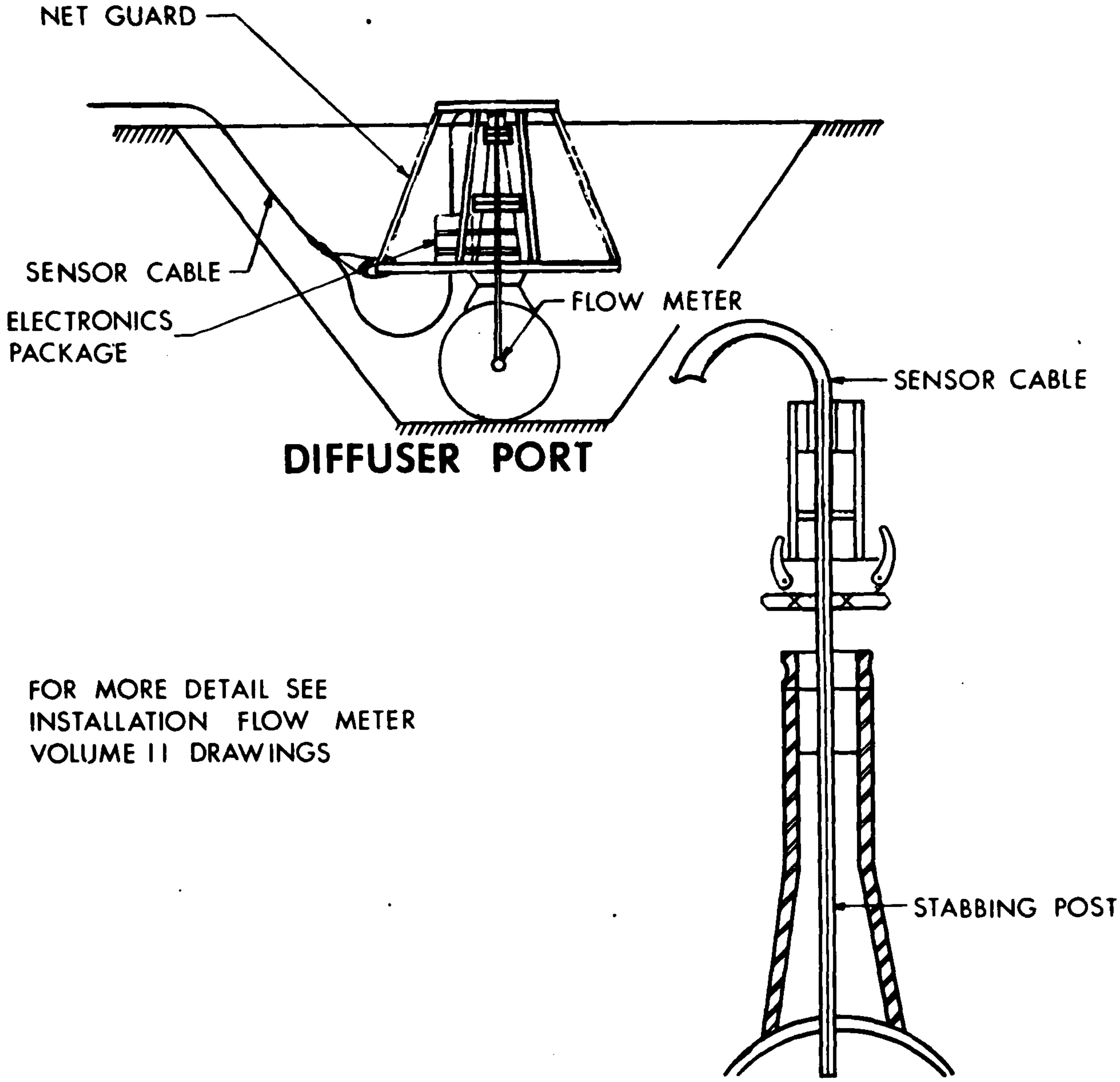
1.2.3.4 Flow Meter

The Flow Meter is a model 551 Water Current Meter manufactured by Marsh-McBirney, Inc., and is identical to the current meter of Chapter 1.2.3.2, with the exception that it is calibrated for a maximum flow rate of 15 ft/sec. For specific ordering information, refer to the purchase description contained in Volume II. The principle of operation is identical to that of the current meter. Since the pipeline is always full, the output of the velocity sensor can be converted directly to flow rate. Details of Flow Meter mounting are shown in Volume II drawing and Figure 1-10.

1.2.3.5 Wind Speed and Direction Sensor

The wind speed and direction sensor is a model VA-320 manufactured by J-Tec Associates, Inc., Cedar Rapids, Iowa. For specific ordering information, the reader is referred to the VA-320 purchase description contained in Volume II.

The VA-320 is a self-contained sensor that provides linear analog voltage outputs corresponding to windspeed and wind direction. For speed sensing, the sensor utilizes the linear relationship between the frequency of vortex formation in the wake of a stationary rod and the speed of the air moving around it. Ultrasonic transducers are used to sense the vortex formation frequency, which is then transformed by the internal electronics to a linear analog output voltage. The speed sensor is mounted in the tail of a vane which is free to rotate about a vertical axis. Wind direction sensing is accomplished by means of a potentiometer coupled to the vane so as to sense the relative position of the vane with respect to the sensor mounting base. This potentiometer thus provides a linear analog output voltage proportional to wind direction.



FOR MORE DETAIL SEE
INSTALLATION FLOW METER
VOLUME II DRAWINGS

FLOW METER INSTALLATION

Figure 1-10

The wind sensor is mounted on a pipe attached to the buoy's mast. Power is provided to the sensor, and sensor outputs are provided to the buoy electronics via a multiconductor cable routed through the gooseneck entrance pipe to a connector on the PCM Encoder Unit.

1.2.3.6 Barometer

The barometer is a model B-242X manufactured by Weather Measure Corporation, Sacramento, California. For specific ordering information, the reader is referred to the B-242X purchase description contained in Volume II.

The B-242X consists of a four-element aneroid cell coupled to the core of a linear variable differential transformer (LVDT). The LVDT and internal electronics produce a linear analog voltage output proportional to the barometric pressure at the sensor location. The barometer is mounted inside the buoy adjacent to the PCM Encoder Unit. Sensor power and output signals are routed via a multiconductor cable to a connector on the PCM Encoder Unit.

1.2.4 On Shore Receiving and Decommutating

This section provides general information on the on shore receiving and decommutating system configuration, operating principles and model identification of individual system components. For more detailed information on the individual system components, refer to manufacturer's manuals and drawings contained in Volume II and the information on operation and maintenance contained in Section 2.4.

1.2.4.1 General

The on shore receiving and decommutating system is composed of a receiving antenna, an FM receiver, a data processor, and a display system. Figure 1-11 shows the arrangement of these subsystems and their data flow paths. Each of the individual units is discussed in detail in the following sections.

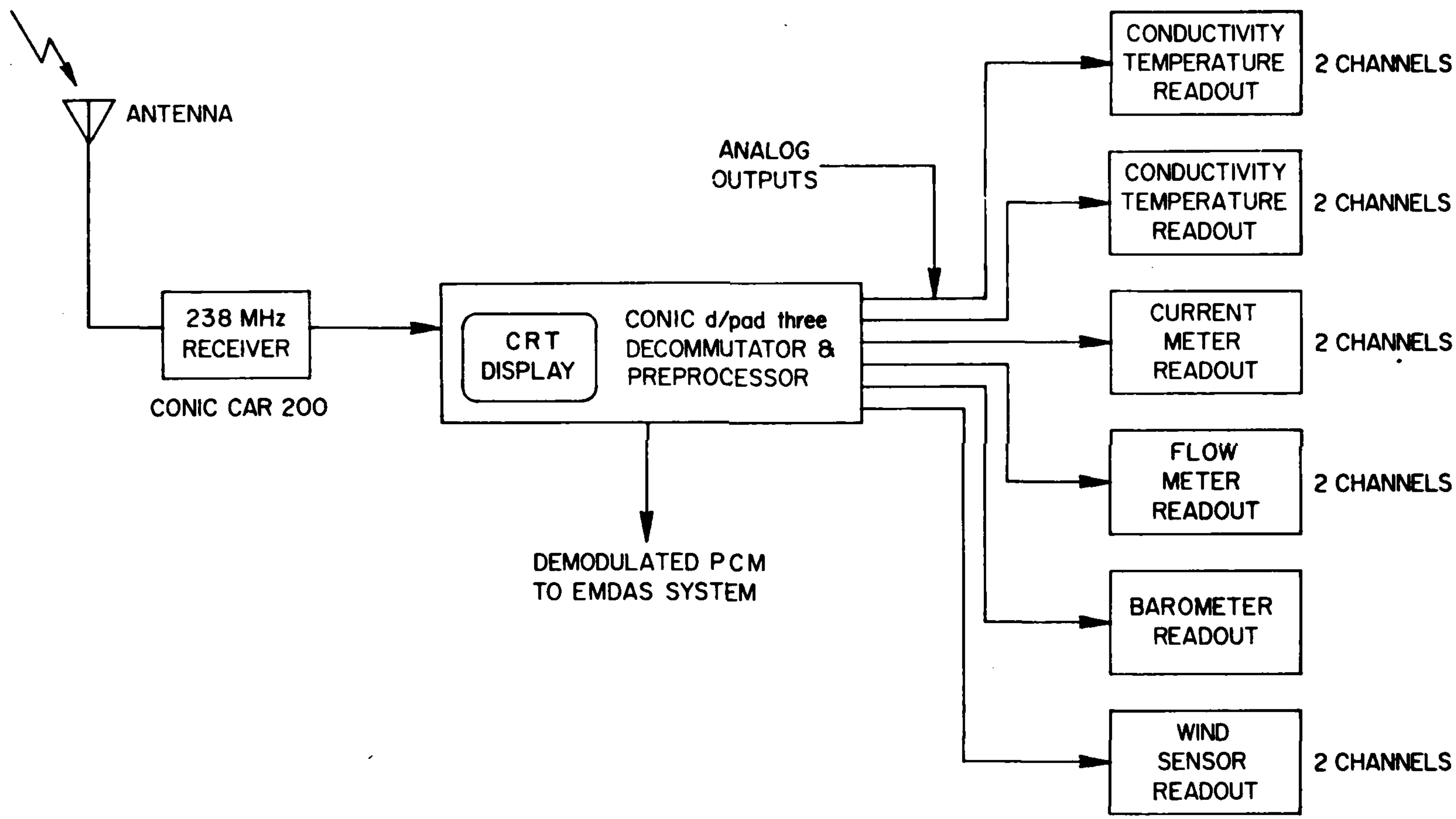
1.2.4.2 Antenna and Receiver System

The receiving antenna is a high band ground plane antenna identical to the transmitter antenna previously described in Section 1.2.2.3. The antenna picks up the buoy transmitted PCM 238 MHz FM signal and routes it to the receiver.

The receiver is a field tunable Model CAR-200 manufactured by Conic Corp., San Diego, Calif. The receiver takes the 238 MHz signal, detects, amplifies and converts it to an audio frequency PCM serial data stream which can be accepted by the decommutator-preprocessor.

1.2.4.3 Decommutator and Preprocessor

The decommutator-preprocessor is a d/pad three data processor manufactured by Conic Data Systems of San Diego, California. For specific ordering information, refer to the purchase description contained in Volume II.



BRIMS SHORE RECEIVING STATION
FIGURE 1-11

The purpose of the decommutator-preprocessor is to accept serially encoded sensor data from the receiver, decommutate and convert it to suitable formats. The d/pad three produces three outputs: a demodulated PCM signal to the EMDAS, 9 separate displays (pages) to an integral CRT, and up to 12 programmable analog signals to rack-mounted direct readout meters. Data can be displayed as binary, decimal, percentage, or converted and displayed in engineering units.

1.2.4.4 Analog Readouts

As previously mentioned, the d/pad three provides up to 12 programmable analog outputs. These are directed to rack mounted direct readout meters. These meters are produced by the appropriate sensor manufacturers listed in Section 1.2.3. Additional meter data can be found in Volume II. These analog readouts provide a display of wind speed and direction, barometric pressure, brine discharge pipeline flow, ocean current, conductivity and temperature in the diffuser field and in ambient ocean water. The displays are in engineering units and which specific sensors' data is displayed is programmable from the d/pad keyboard.

2.1 Buoy and Mooring Maintenance

The structural components of the buoy and mooring are expected to require only minimal maintenance. The Navy Standard Mooring Maintenance manual is included in Volume II. That manual calls for a complete replacement of moorings and buoys every three to five years; however, it must be realized that Navy moorings are used to moor large ships and, hence, receive rather extensive wear damage and abuse. In water, lifetime of the BRIMS buoy and moorings is expected to be well in excess of the 3 to 5 year period. An inspection of the buoy and anchor legs should be done after the passage of any major storm.

2.1.1 Buoy Maintenance

Buoy maintenance consists of periodic inspection, cleaning, painting, hatch greasing, and annode replacement.

Prior to implantment, the buoy was sandblasted and painted in accordance with milspec Mil-P-2444, which includes an initial coat of two-part mar epoxy primer and a secondary coat of two-part marine epoxy overcoat. This painting schedule is expected to last at least 3 to 5 years. Fouling does occur on the hull of the buoy, but it does not affect the coating nor does it have any significant adverse effect on the mooring; hence, removal of the fouling should not be necessary nor is it recommended since it may also damage the coating system.

The above water surface of the buoy may be repainted annually for cosmetic effect and insurance of high visibility. Surface repainting should maintain the present red-white striping scheme which is required for marker buoys. Application of non-skid to all walking surfaces is recommended. Buoy interior painting is not recommended. Spot painting to reduce rust spots is all that may be necessary.

The hatch dogs should be greased on a semiannual basis, and the hatch gasket should be greased with silicone, also, semiannually.

Buoy fenders should be replaced as necessary. Buoy anodes should be replaced as necessary. Note: The existing three buoy anodes are welded onto the buoy side hull about 2' below the waterline. To replace anodes, the side of the buoy must be lifted by a crane or A-Frame and a new anode must be welded on. It is advisable, however, to weld on new brackets so that new anodes may be bolted onto these brackets to avoid recurring anode replacement costs.

2.1.2 Mooring Maintenance

The mooring legs should be diver inspected annually. Wear of chain legs is normally most pronounced at the attachment point to the buoy and at the touch point between the chain and the seafloor. The Navy recommends complete replacement of anchor legs after the chain has had its wire diameter reduced to 80% of the original diameter. Again, it must be noted that this is for buoys used to moor ships. After one year of BRIMS buoy implantment, a diver inspection revealed no noticeable wear; hence it is expected that mooring leg maintenance will not be required for at least five years.

The eastern mooring leg crosses over the Brine Line. When originally installed, this leg was suspended in a cateneary 8-10' above the Brine Line. This leg should be inspected after any major storm to assure that no movement or shifting of the mooring has occurred which would permit the chain to chafe on the pipeline. (This, in fact, occurred during the passage of Hurricane Allen in August 1980). If necessary, corrective action by pulling the leg taut should be taken; however, care should be taken to either loosen or temporarily disconnect all cables extending from the buoy to underwater sensors to avoid undue tension from being applied to the cables during buoy movement. After buoy movement and reconnection of cables, divers should inspect each cable to assure that it does not chafe against any of the chain legs.

2.2 In-Buoy Electronics Maintenance

2.2.1 Operating Procedures

The following section discusses the normal turn on and check out procedures for the on-buoy electronics and navigation aids. In the event a malfunction occurs during these procedures, refer to Section 2.2.3, Corrective Maintenance.

2.2.1.1 System Operational Check

Turn on and check out of the system should be as follows:

(1) Arrange for communication with the shore receiver site for verification of data transmission and data validity.

(2) Locate the Power ON/OFF and the TEST/NORMAL switches atop the cover of the Timer/Transmitter Unit.

(3) Set the Power ON/OFF switch to OFF.

(4) Set the TEST/NORMAL switch to TEST. This action bypasses the timing logic unit and allows all other electronics to be activated as soon as the ON/OFF switch is turned on.

(5) Connect the batteries as shown in Volume II drawing. Use a voltmeter to check the assembled batterypack voltages.

(6) Set the Power ON/OFF switch to ON. This should immediately activate all electronic systems. The transmit indicator should light. Data should be transmitted to the on-shore receiving site. Confirm data transmission and validity with the site.

(7) Set the Power ON/OFF switch to OFF.

(8) Set the TEST/NORMAL switch to NORMAL.

(9) Return the Power ON/OFF switch to ON and NOTE THE TIME! Now only the TIMING LOGIC UNIT is activated, and all other electronics

are disabled. After the preselected interval (30 minutes) has elapsed, the timer will apply power to the rest of the buoy electronics and will gather, process, and transmit data for a preset duration (6 minutes).

(10) Verify this 6-minute transmission with the on-shore receiving site. Six-minute data samples should be transmitted every 30 minutes with the system operating in this normal configuration. Use the Power ON/OFF switch to reinitiate the timer to start the 6-minute transmissions exactly on the hour and half hour. <u>Note</u>: Transmitter interval and duration may be set for other values than the 6-minute every 30 minutes mode by switches on the timer card 2. See timer manual in Volume II. See Figure 2-1.

2.2.1.2 <u>Bilge Pump System Check</u>

Manually activate the water level sensor in the bilge pump system. Observe pump for proper operation and verify "Pump On" data is being transmitted to the on-shore receiver site.

2.2.1.3 <u>Navigational Aids Check</u>

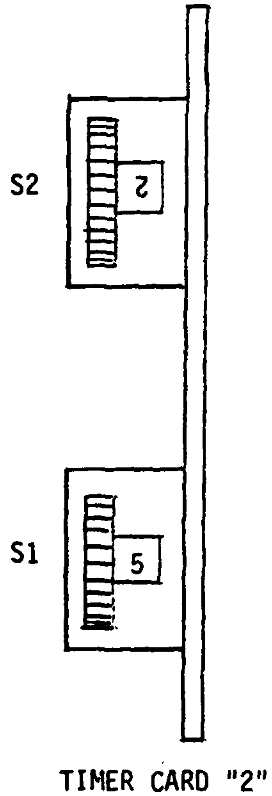
Check Fog Signal for proper operation. It should produce a 2-second blast every 20 seconds.

The Lantern/Flasher can be checked in daylight by covering the entire lens with dark cloth. This should activate the sunswitch which will turn on the lamp.

2.2.2 <u>Periodic Maintenance</u>

Periodic maintenance of the in-buoy electronics will consist primarily of visual inspection for environmental effects on the equipment and the

degradation of the battery systems. The equipment should be checked for excessive moisture build-up, corrosion, loose connections, and damaged conductors. Following the procedures outlined in Section 2.2.1 and the manufacturers' manuals in Volume II, check the various battery systems, the operation of the bilge pump, and the navigational aids.



SAMPLE INTERVAL	THUMBWHEEL SETTING
10 Min	1
30 Min	2
1 Hr	3
2 Hr	4
4 Hr	5

SAMPLE DURATION	THUMBWHEEL SETTING
30 Sec	1
1 Min	2
2 Min	3
3 Min	4
4 Min	5
6 Min	6

FIGURE 2-1   THUMBWHEEL LOCATION AND SETTINGS

2.2.3 Corrective Maintenance

2.2.3.1 In-Buoy Maintenance

In-buoy corrective maintenance consists of isolating malfunctions to one or more major in-buoy subsystems and replacing the defective unit(s) with spares. In-buoy checks can also be performed to determine if a malfunction is due to defective sensors and/or sensor cables, but in the case of defective underwater sensors/cables, diver support is required for replacement; and this will normally require another field trip at a later time.

The following items should be taken to the buoy for trouble-shooting and parts replacement:

(1) A spare antenna and RF cable.

(2) An inline wattmeter capable of measuring 6 watts and 238 MHz and both forward and reverse power.

(3) A high impedance voltmeter.

(4) A spare Timer/Transmitter Unit.

(5) A spare PCM/Interconnection Unit.

(6) An inline Sensor Test Unit.

(7) Spare Meteorological Sensors (if indicated).

2.2.3.1.1 Battery Subsystem Corrective Maintenance

Prior to any trouble shooting of in-buoy electronics, the battery subsystems should be checked for proper operation. These checks should be performed with all system electronics operating as follows:

(1) Place Power ON/OFF switch to ON and TEST/NORMAL Switch to TEST.

(2) Using Figure 1-5 and Volume II drawings, check all combined and individual cell voltages.

(3) If all voltages are correct, proceed to Section 2.2.3.1.2.

(4) If measured voltages are low or missing, check for loose or corroded connections. If indicated, change batteries to correct voltage problems.

(5) Perform system operational check as described in Section 2.2.1.1. If system malfunctions still exist, proceed to Section 2.2.3.1.2.

2.2.3.1.2 <u>Electronics and Sensor Systems Corrective Maintenance</u>

The following indicates the sequence of steps to be used to isolate malfunctions to the major Electronics and Sensor Systems and the indications that should be present at each step. The procedures are subdivided by the symptoms that have indicated a malfunction.

NO RF SIGNALS TRANSMITTED TO THE SHORE SITE

(1) Place the Power ON/OFF switch to OFF.

(2) Place the TEST/NORMAL switch to TEST.

(3) Install an inline wattmeter between the transmitter and antenna.

(4) Place the Power ON/OFF switch to ON. The XMIT indicator should light.

(5) The wattmeter should indicate 5 watts minimum with a VSWR of 1.5:1 or less. If wattmeter indicates low or no output, replace the Timer/Transmitter Unit and proceed to Step 8.

(6) If the VSWR is excessive, turn the power OFF; closely inspect the antenna and RF cable for damage or other problems.

(7) If no visible indications, replace the antenna and cable, turn power ON, and proceed to Step 8.

(8) Recheck the power out and VSWR. If normal now, verify transmission with shore site.

(9) Place the Power ON/OFF switch to OFF.

(10) Place the TEST/NORMAL switch to NORMAL and NOTE THE TIME.

(11) After the selected interval (30 minutes), the transmitter should radiate for the selected duration (6 minutes).

(12) The XMIT indicator will light during transmission. Verify the transmission with the shore site.

(13) Turn the Power OFF.

(14) Remove the wattmeter.

(15) Reinitiate the timer on the hour or half hour by placing the Power ON/OFF switch to ON at either of these times.

SOME OR ALL TRANSMITTED SENSOR DATA IS BAD

(1) Place the Power ON/OFF switch to OFF.

(2) Place the TEST/NORMAL switch to TEST and the Power ON/OFF switch to ON.

(3) If onshore test indicates that RF is received, but all sensor data is bad and the d-pad III lock-on indicator does not light, turn power OFF, replace the PCM/Interconnection Unit, and proceed to Step 11. If lock-on indicator lights, but sensor data is bad, continue to Step 4.

(4) Disconnect from the PCM/Interconnection Unit the cable for any one of the sensors whose data is missing or erroneous.

(5) Connect the INLINE SENSOR TEST MODULE between the PCM Encoder Unit and the sensor cable.

(6) Use a high impedance electronic voltmeter to check the voltage and signal levels in the cable. The pin numbers and voltages for each type of sensor are shown on figures 2-2, 2-3, and 2-4.

(7) Sensor signal outputs should be checked against sensor calibration curves in Volume II to determine if measured values are reasonable.

(8) Repeat Steps 4, 5, 6, and 7 for each of the suspect sensor cables in turn.

BAROMETER CABLE CHECK

PIN NUMBER	FUNCTION	MEASUREMENT
1	SIGNAL	$\pm$0.150 VDC (975-1025 mb)
2	N. C.	
3	BATTERY	+12 VDC
4	POWER AND SIGNAL GND.	
5	N. C.	
6	N. C.	
7	N. C.	
8	N. C.	

Figure 2-2

CT SENSOR CABLE CHECKS

PIN NUMBER	FUNCTION	MEASUREMENT
1	POWER GND.	-12 VDC
2	(+) BATTERY	+12 VDC
3	CONDUCTIVITY SIGNAL	+.25 VDC to +2.5 VDC
4	CONDUCTIVITY GND.	
5	TEMPERATURE SIGNAL	0.0 to 0.5 VDC
6	TEMPERATURE GND.	
7	NO CONNECTION	
8	NO CONNECTION	

CURRENT METER/FLOW METER SENSOR CABLE CHECK

PIN NUMBER	FUNCTION	MEASUREMENT
1	"Y" SIGNAL	0 to $\pm$2.5 VDC
2	CAL. CONTROL	*
3	MAG. GND.	
4	(+) BATTERY	+12 VDC
5	(-) BATTERY	-12 VDC
6	"X" SIGNAL	0 to $\pm$2.5 VDC
7	SIGNAL GND.	
8	NO CONNECTION	

*WHEN +12 VDC IS APPLIED TO PIN 2, A RETURN OF APPROXIMATELY 1.25 VDC SHOULD BE MEASURED AT BOTH PINS 1 AND 6 WHEN A SENSOR IS FUNCTIONING PROPERLY.

Figure 2-3

WIND SPEED AND DIRECTION SENSOR CABLE CHECK

PIN NUMBER	FUNCTION	MEASUREMENT
1	WIND VELOCITY SIGNAL	0-2.5 VDC
2	WIND DIRECTION SIGNAL	0-2.5 VDC
3	(+) BATTERY	+12 VDC
4	GROUND, SIGNAL OR POWER	
5	N. C.	
6	N. C.	
7	N. C.	
8	N. C.	

Figure 2-4

(9) If the check indicates a bad sensor, disconnect that cable until a replacement can be brought out and installed; and proceed to Step 12.

(10) If all of the sensor cable voltages check out good, then the PCM/ Interconnection Unit is defective and should be replaced with a spare.

(11) After the PCM/Interconnection Unit has been installed, place the ON/OFF switch to ON.

(12) Verify that the shore station is receiving data for all connected sensors now.

(13) After this has been verified with the shore, place the TEST/NORMAL switch to NORMAL and verify valid data transmission on the hour and half hour for six-minute durations.

Any time the Timer/Transmitter Unit or the PCM/Interconnection Unit are opened and reclosed, they should be charged with nitrogen in the following manner:

(1) Connect the nitrogen tank to the airvalve on the unit.

(2) Open the tank valve and leave it open for 2 minutes.

(3) Disconnect the nitrogen tank and purge the unit through the air-valve for 2 minutes.

(4) Repeat Steps 1 through 3.

(5) Charge the unit a third time and leave charged.

2.2.3.2 Bench Maintenance

Other than repair of internal wiring or connections, bench maintenance will consist of isolating malfunctions to major sub-units and returning these to their manufacturer for repair.

If a Timer/Transmitter Unit has been replaced due to a malfunction, the defective unit should be opened and the trouble isolated as follows:

(1) Connect an inline wattmeter and an antenna or other 50 ohm load to J3.

(2) Place the ON/OFF switch to OFF.

(3) Place the TEST/NORMAL switch to TEST.

(4) Supply the following voltages to the unit via J1: Pin 1 +12 VDC, Pin 5 +28 VDC, Pin 3 -12 VDC, and Pins 2 and 4 Ground.

(5) Place the ON/OFF switch to ON and observe the XMIT indicator and the wattmeter. If the XMIT indicator lights but the wattmeter indicates no or low power (less than 5 watts), the transmitter unit is defective and should be returned for repair. If the XMIT indicator fails to light, proceed with the following checks:

(6) Use a voltmeter and check for the following voltages at J2:

Pin 15	+12 VDC
Pin 22	+28 VDC
Pin 5	-12 VDC
Pin 20	GROUND

If any of the readings taken in Step 6 are incorrect, the Relay Card #3 is defective and should be returned for repair. If the readings are normal, proceed with the following steps:

(7) Place the ON/OFF switch to OFF.

(8) Place the TEST/NORMAL switch to NORMAL.

(9) Note the time and place the ON/OFF switch to ON.

(10) After the selected interval (30 minutes), make the same checks as in Step 6 above. The voltages should remain present for the selected duration (6 minutes). If the readings taken in Step 10 are not present at the proper time or for the proper duration, the malfunction is in the timer Cards 1 and 2; and they should be returned for repair.

If the PCM/Interconnection Unit has been replaced, the unit should be opened and a check made of internal wiring and connections. If no defects are found, the PCM-410 Encoder must be defective and should be returned to the manufacturer for repair.

2.3 Sensor System Maintenance

At-sea maintenance of BRIMS sensors consists primarily of cleaning and inspection. Sophisticated checkout and maintenance should be done in the laboratory or at the manufacturer's plant.

2.3.1 Periodic Maintenance

2.3.1.1 Sensor Maintenance

The C-T sensors, the current meter, and the flow meters all have anti-foulant protection. The conductivity cell of the C-T is coated with a standard marine bottom paint. The current meter and flow meters are impregnated with a B. F. Goodrich patented rubber anti-foulant. The C-T painting system is expected to give up to 6 months' protection from fouling, whereas the current meter and flow meter protection can last beyond 5 years.

The C-T's should be inspected and cleaned every 3 months, particularly during the summer months when fouling organisms (primarily barnacles) are most active. Particular care should be taken to clean the interior hole of the donut-shaped sensor head. This may be done by divers with a toothbrush and a dull scraper. Care should be taken not to damage the protective coating. The C-T's should be replaced with freshly painted and recalibrated sensors every 6 months, or more often if fouling becomes excessive.

The current meter should also be inspected every 3 months. The anti-foulant protects the satellite-shaped sensor head but does not protect the four small knob-like sensor projections. These projections should be cleaned with a toothbrush and/or a dull scraper. The current meter sensor stand should be inspected to assure that it is upright and that the welded arrow (see systems drawings, Volume II) and sensor are in the proper orientation. Replacement of the current meter should only be done if there is a systems malfunction.

The flow meters should only be removed for inspection if shore-side readings indicate a malfunction. Fouling by accumulation of saline deposits is not likely. Typically, no at-sea maintenance other than complete replacement can be performed. The anemometer requires virtually no at-sea maintenance other than external cleaning. The barometer requires no at-sea maintenance.

2.3.1.2 Cable Maintenance

Cables should be inspected every 3 months to assure that they have not become enfouled in any bottom debris or have entangled in the mooring chains. The point at which the cables exit the buoy hawse pipe should be inspected every 3 months and, if chafe is evident, the cables should be raised or lowered slightly to stop wear at that point.

Note: A stopper (similar to a cork in a bottle) plugs the bottom of the buoy hawse pipe. This stopper is held in place by a nylon line which extends up through the hawse pipe and is tied at the top of the work platform. The stopper is used to restrict motion and chafing of the cables at the bottom of the buoy hawse pipe.

2.3.2 Sensor Corrective Maintenance

2.3.2.1 At-Sea Corrective Maintenance

Corrective maintenance of sensors may be necessary whenever shore-side readings indicate a failure (erratic or unreasonable readings, or no reading). In-buoy components should be inspected first, as described in Section 2.2.3. If positive indication of sensor or cable failure is determined, then the sensor and/or cable should be completely replaced as discussed in Chapter 2.3.3.

2.3.2.2 Sensor Bench Maintenance

Sensor bench maintenance will be relatively limited. Sensors which have been removed from the system because of suspected malfunctions should be further checked using the manufacturers' manuals found in Volume II. Once specific symptoms have been documented, these should be forwarded with the sensor to the manufacturer for repair under the warranty. As previously mentioned in Section 1.2.3.1, the sensors returned from the manufacturer after repair should be calibrated before being reinstalled in the system.

2.3.3 At-Sea Sensor and/or Cable Replacement

Sensor replacement may be deemed necessary for either of two reasons: (1) scheduled replacement of C-T sensors, or (2) system malfunction of any one of the in-water sensors and/or cables. Section 2.3.3.1 discusses the means to determine if the malfunction is in the sensor or the cable.

2.3.3.1 C-T Replacement/Installation

If a C-T sensor is in need of replacement for either programmed maintenance or sensor malfunction, only the sensor end of the cable must be raised to the surface. Present operations require the use of divers to effect retrieval.

Operations to retrieve a C-T sensor proceed as follows: The diving vessel ties up to the BRIMS buoy and personnel board the buoy. The particular cable to the sensor to be replaced is identified by people on the buoy, and the line to the stopper described in Section 2.3.1.2 is loosened. A diver enters the water and pulls down the stopper. The particular sensor cable is pulled on by personnel on the buoy to aid the diver's identification of it. The diver then follows the cable out to the sensor as the diving vessel follows his traverse. Once at the sensor, the diver calls for a lowering line and attaches the line to the sensor anchor. The diver returns to the vessel and people on the vessel pull up the sensor and cable end. (Refer to Volume II systems drawings for configuration of conductivity and water temperature sensor installation, float and anchor).

The old sensor is then disconnected from the cable by decoupling the underwater connector. The sensor may then be checked using the appropriate power source and the in-line tester as described in Section 2.2.3. If the sensor functions properly, then the cable should be checked for continuity and resistance between conductors; this requires radio communication between the dive vessel and personnel on the buoy.

If the cable checks good and the sensor appears bad, a new sensor is installed and is lowered to the bottom by a lowering line. A diver follows down the lowering line to the sensor, assures proper orientation, removes the lowering line, and returns to the surface.

If the C-T cable is determined to be faulty, complete replacement is necessary. If possible, the old cable and sensor should be retrieved to avoid potential entanglement with the new cable and for possible reuse of the sensor and the undamaged part of the cable.

The old cable may be removed by following the same procedure as described above to bring the end of the cable aboard. The cable is then hauled aboard by hand and coiled in a figure eight. The buoy end of the cable is disconnected and pulled out and aboard the vessel.

Replacement of C-T sensors and cable proceeds essentially in the reverse order as that for retrieval.

Navigation for sensor positioning is done by using the LORAN-C. LORAN positioning in the BRIMS area is typically quite accurate; however, stations tend to drift on a daily basis on the order of one to two-tenths of a microsecond. To compensate for this drift, the implant vessel must take position adjacent to the BRIMS buoy. By comparing the known position of the buoy on the expanded LORAN-C chart (see system drawings, Volume II) with the readout on the LORAN receiver, the proper correction factors for that particular day may be determined.

Preparation for cable laying consists of attaching the C-T sensor and anchor to the cable on the deck of the installation vessel. (See system drawings, Volume II). The cable is precut to the required length, which is 110% of horizontal track length plus 100 feet for rise into the buoy and excess in the buoy for routing.

The cable is neatly coiled in a figure eight on the stern of the implant vessel. The end going into the BRIMS buoy is on top.

The deployment vessel ties up to the BRIMS buoy. A diver enters the water carrying the bitter end of the cable with him. Personnel on board the buoy

loosen the stopper plug, and the diver pulls it down about 25 feet. The end of the cable is then attached to the stopper line, and it is pulled up into the buoy by the people on the buoy. The end of the sensor cable is then routed down the gooseneck into the inside of the buoy. A Preformed Line Products (PLP) Dynagrip is attached to the cable and shackled into the stopper hanging bar mounted on the top of the 24" mast pipe.

The deployment vessel then proceeds along its prescribed cable track. Cable is payed out of the figure eight on the stern by hand. At the end of the cable run, the sensor is lowered with a lowering line attached to a surface float. Upon confirmation from buoy personnel that the sensor is operating, a diver descends along the lowering line, checks that the sensor is oriented properly, removes the lowering line, and returns to the surface.

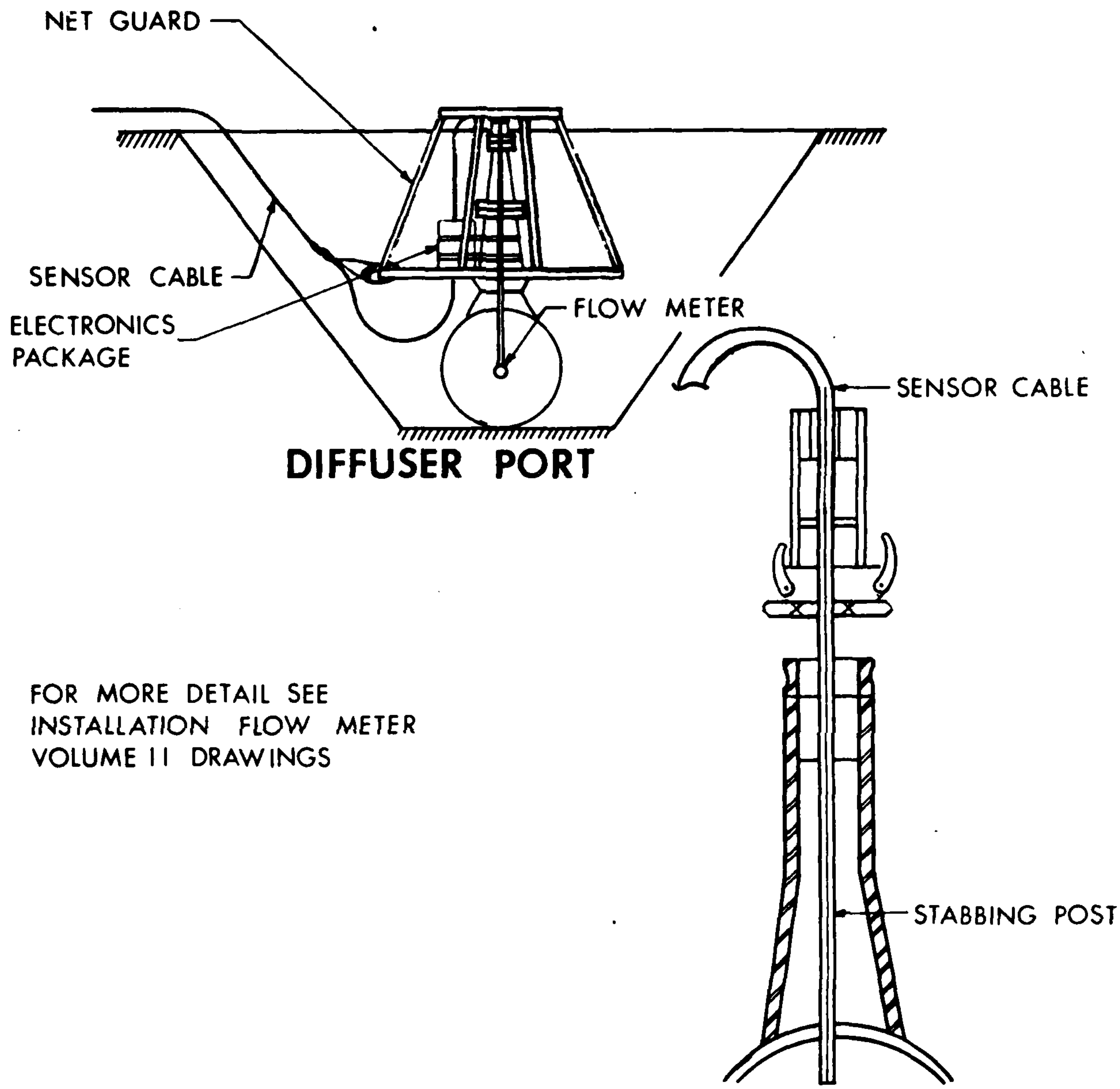
2.3.3.2 Flow Meter Replacement/Installation

Flow meters are inserted in the 1st and 2nd diffuser ports via the mounting shown in Figure 2-5 and in Volume II systems drawings.

The number one and number two diffuser ports are located approximately 910 feet and 845 feet respectively in a northwesterly direction from the BRIMS buoy.

The removal of the old flow meter and the installation of a new one must proceed rapidly, since flow in the pipeline must be secured and typically there is only a finite time (one to two hours) that the pipe can be shut down.

Removal and installation operations proceed as follows: A diver (using live boat method) descends on and follows the old flow meter cable to ascertain the status of the cable and the old meter. He must assure that removal is free of any impediments. Typically, location of the 1st and/or 2nd diffuser ports is simply effected by following the old flow meter cable to the diffuser port.



FOR MORE DETAIL SEE
INSTALLATION FLOW METER
VOLUME II DRAWINGS

FLOW METER INSTALLATION

Figure 2-5

If it appears from the diver inspection that the sensor cable is intact, the old meter and cable should be brought to the surface. WARNING: Flow must be shut off prior to removal of the old meter, or injury to the diver could occur. Flow at the diffuser should be completely stopped 20 minutes after shore side shut-down. Once the meter is on the surface, cable and sensor check out procedures are identical to those described in Section 2.3.3.1.

If the cable is damaged, new cable must be layed in the manner described in Section 2.3.3.1, with the following differences: (1) Since the cables must go to fixed positions, additional slack is layed to reduce possibility of buoy's motion in storms pulling on the sensor end. Cable length to diffuser No. 1 is 1,200 feet, and to diffuser No. 2 it is 1,150 feet; (2) Navigation is done by visually proceeding to the proper diffuser port, which must be premarked with a buoy.

If the cable has been parted, the 1st and/or 2nd diffuser port must be located and a descent line attached to it. The ports will be located by first identifying the 15th diffuser port (previously used with a flow meter) and working back along the pipeline trench in a northwesterly direction to the number one and/or number two diffuser ports. The 15th diffuser port is readily located by descending along the eastern mooring leg of the BRIMS buoy. This leg passes over the pipeline between ports 15 and 16. Hence, the diver can relocate the port by following the chain to the pipeline trench and then turning north (towards shore). The first port encountered should be port 15. The net guard over this port has two holes burned into the top ring, one hole on the shoreward and one on the seaward side aligned with the pipeline axis. The diver at this point can tie a seventy-foot line to the net guard and, heading in a northwesterly direction, travel seventy feet and swing an arc with the line

to find the next diffuser port, the ports being about 60 feet apart. This procedure will be repeated until the diver reaches number two and/or number one diffuser ports. The diver can also follow the pipe trench using live boat method if visibility permits. Positive identification of the ports can be made by the following means: (1) The old sensor mount should still be in the port; (2) Ports 1 and 2 do not have check valves (all other ports do); and (3) The port net guards have two large nylon tie straps fastened to the top rings, one strap on the shoreward and one on the seaward side, aligned with the pipeline axis. A descent line and buoy are then attached to the port. Cable is then layed, starting at the BRIMS buoy as described before and proceeding to port 1 or 2.

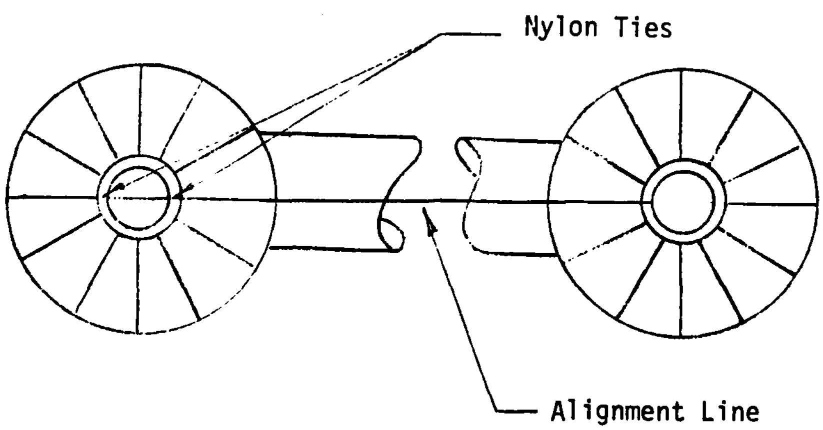
The new flow meter with stabbing post, electronic package, and cable should be configured as shown in Volume II system drawings.

The sensor with stabbing post and electronics is then lowered by line at the diffuser port site, the diver enters the water and descends to the diffuser, and he installs the new sensor system. A lift bag may be used to help in the installation. The sensor should be installed in such a manner that the attached cable is threaded from below and into the interior of the net guard so that no cable protrudes from the side or top after the sensor is installed. A jet pump may be required to excavate mud at the base of the net guard. The electronics package is secured to the diffuser housing using two 1" nylon straps and buckles, and the cable is secured at the base of the net guard using a PLP grip with a 6' W.R. strap and clips.

Care must be taken to align the sensor probe's X-X axis with the longitudinal axis of the flow pipe. This is accomplished by having attached a right angle piece of angle iron to the top of the stabbing post prior to submersion, so

that the horizontal segment will be just above the top ring of the net guard when the sensor is installed. The diver should then be able to feel the large nylon tie strap on the net guard ring and align the sensor probe by placing the horizontal segment of the angle iron over the nylon tie strap. If the nylon tie strap is missing, the diver will have to establish the flow or longitudinal axis of the pipeline in the following manner: The diver will affix the end of a line to an adjacent diffuser net guard and pull the line taut and affix the end of the line to the net guard so that the line passes over the center of the diffuser where the sensor is to be installed, as shown below. This will serve to help in aligning the flow meter. More permanent alignment markers may be placed on the top ring of the net guard at this time.

After the sensor installation, the diver should follow the cable back to the buoy to assure that it is not entangled. The control room at Bryan Mound is then radioed to restart the flow, and meter operation is checked in the buoy and ashore.



2.3.3.3 Current Meter Replacement/Installation

The current meter arrangement, which is located within 75 feet of the BRIMS buoy, is implanted in a manner similar to that of the C-T sensors, with the obvious exception that it is incorporated into a metal stand as shown in Volume II system drawings.

The current meter arrangement must be aligned with north. To do this requires some slight visibility for a diver to see his compass. Alignment marks are placed on the sensor stand. The diver must align these marks with his compass and then seat the legs of the stand with attached electronics housing and sensor cable into the bottom. The diver should also make certain that the sensor is in a vertical position. It may be necessary for the diver to use jetting equipment to seat the stand in place.

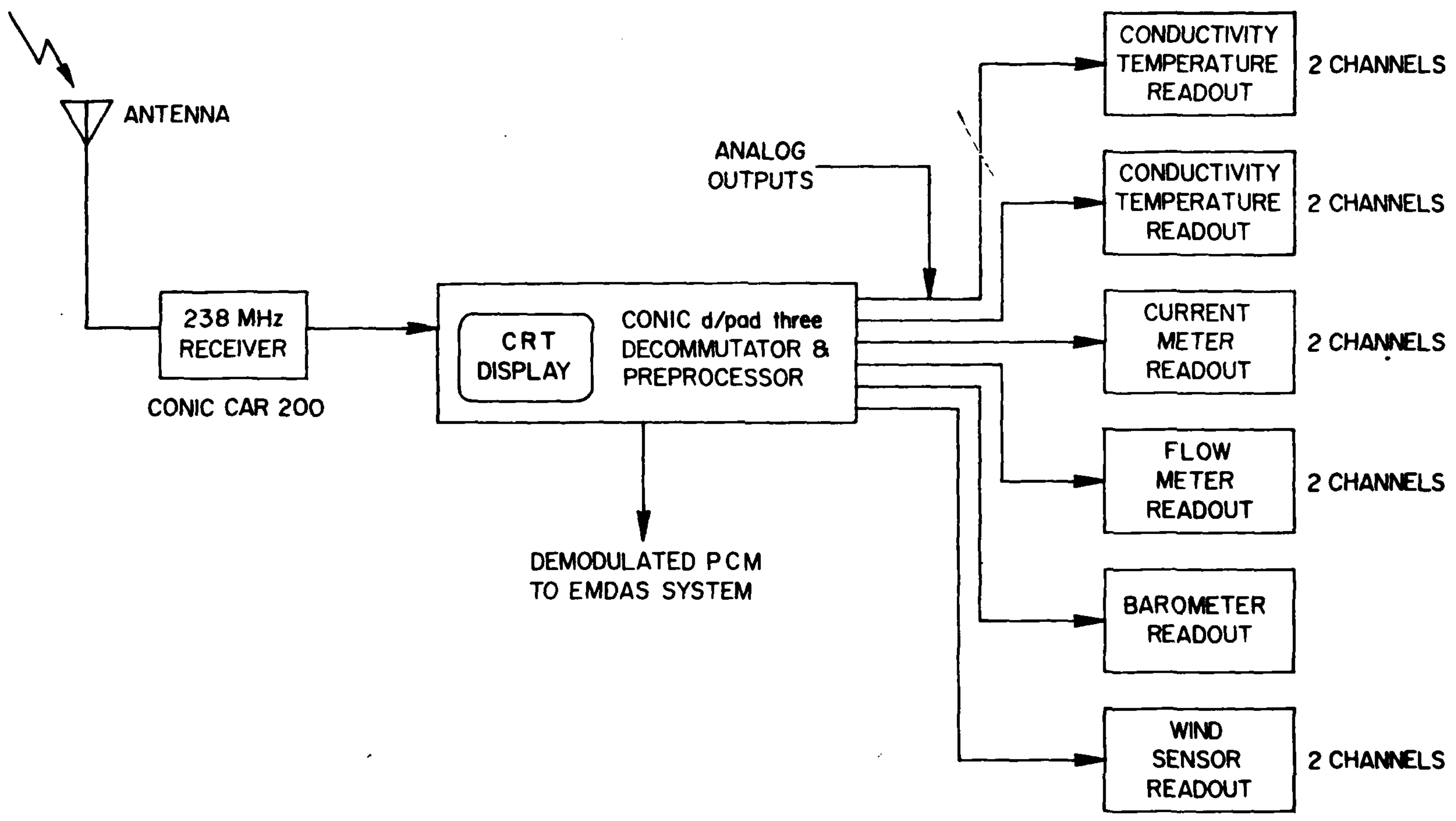
2.4 ON SHORE RECEIVING AND DECOMMUTATING

2.4.1 OPERATING PROCEDURES

Operating the on-shore system will consist of basically three stages: (1) Interconnecting the subsystem, (2) applying power to the system, and (3) operating the d/pad three data processor. Figure 2-6 shows the necessary system interconnection. The voltage requirements are +28 VDC for the receiver and 110 VAC for the d/pad three. The user is referred to the d/pad three data processor operation and maintenance instruction manual for operating procedures. For use with the BRIMS, pages 1, 2, and 3, displayed on the CRT, must be set as shown in Figures 2-7 and 2-8. In addition, the proper slope (m) and intercept (b) coefficients must be entered on each sensor engineering unit's conversion page (page 01). The coefficients for sensors currently installed may be obtained from the calibration data in Section 3.3 of Volume II. It should be remembered that new calibration coefficients must be inserted in the appropriate sensor engineering unit's conversion page(s) whenever a sensor or sensors are replaced.

2.4.2 PERIODIC MAINTENANCE

The only item requiring periodic maintenance in the on-shore system is the d/pad three. The reader is referred to Section V of the manufacturer's operation and maintenance manual for specific instructions (See Volume II).



BRIMS SHORE RECEIVING STATION
FIGURE 2-6

BIT SYNCHRONIZER

DATA MODE.	PCM
CLOCK SOURCE	INTERNAL
CLOCK POLARITY	POSITIVE
DATA SOURCE.	3
BIT RATE	*25.00 EE 2
TRACK RANGE.	01.0%
LOOP BANDWIDTH	8.8% AUTO
BIT ERROR RATE:	
(ALARM SET).	00.00

BIT SYNCHRONIZER (PAGE 1)

FIGURE 2-7

*BIT RATE MAY BE DIFFERENT THAN THAT SHOWN ABOVE, DEPENDING UPON THE SPECIFIED BIT RATE OF THE PCM-410 ENCODER BEING USED. THIS BIT RATE IS SPECIFIED ON THE ENCODER LABEL.

FRAME SYNCHRONIZER	2
BITS/WORD	12
WORDS/FRAME	037
PARITY.	NONE
DATA CODE	DM-M
DATA POLARITY	NORMAL
DATA ALIGNMENT.	MSB FIRST
FRAME SYNC CODE	11111010111 10011001000 00XXXXXXXXX
SYNC STRATEGY:	
SEAPCH LOCK	01 CORRECT
LOCK SEARCH	01 ERRORS

SUBFRAME SYNCHRONIZER	3
FRAMES/SUBFRAME	001
SYNC METHOD	NONE
SYNC LOCATION	
BIT	00
WORD	000
STARTING ID	000
COUNT DIRECTION	UP
SYNC CODE	XXXXXXXXXXX XXXXXXXXXXX XXXXXXXXXXX
SYNC STRATEGY:	
SEARCH LOCK	01 CORRECT
LOCK SEARCH	01 ERRORS

FRAME AND SUBFRAME SYNCHRONIZER (PAGES 2 AND 3)

FIGURE 2-8

2.4.3 CORRECTIVE MAINTENANCE.

With the exception of the d/pad three, the on-shore corrective maintenance for individual units will consist of isolation and substitution. If data is lost from an analog direct readout, but is still available on the d/pad three CRT and analog outputs, then the readout is suspect and should be replaced. In the event that all data is lost, a check should be made at the output of the receiver for video. If no video is present, the receiver should be replaced and the output rechecked. Should the signals continue to be missing and there are not apparent antenna problems, then a buoy electronics problem is probable. When the outputs of the receiver are found to be normal, but the CRT and direct readouts are not, then the problem is within the d/pad three. Here again, the user is referred to the manufacturer's operation and maintenance manual, Section V. (See Volume II for d/pad three operation and maintenance manual).

2.5 RECOMMENDED MAINTENANCE SCHEDULE

Sensor Systems:

C-T Sensors: Inspect and clean every 3 months, replace every 6 months.

Current meter: Inspect and clean every 3 months.

Flow meter: Remove for inspection only if shore side readings indicate a malfunction.

Anemometer: Periodic external cleaning only.

Barometer: No at-sea maintenance.

Cables: Inspect every 3 months. (See maintenance section for details).

On-Shore Receiving & Decommutating:

The only item requiring periodic maintenance in the on-shore system is the d/pad three data processor. Refer to Section V of the d/pad three manual located in Volume II. (Also see maintenance section for details).

Buoy:

Buoy maintenance consists of periodic inspection, cleaning, painting, hatch greasing, and annode replacement.

Above water surface painting: Annually.

Hatch dogs: Grease semiannually.

Hatch gasket: Grease with silicone semiannually.

Buoy fenders: Replace as necessary.

Buoy anodes: Replace as necessary.

(See maintenance section for details).

2.5 RECOMMENDED MAINTENANCE SCHEDULE

Mooring:

Diver inspected annually or after any major storm. (See maintenance section for details.)

In Buoy Electronics:

Periodic visual inspection for environmental effects on the equipment and the degradation of the battery systems. (See maintenance section for details.)

2.6 RECOMMENDED SPARES

1 Transmitter and Timing Logic Unit

1 PCM/Interconnection Unit

50 ST-22 Batteries

1 Transmitter/Receiver Antenna

1 Conic Receiver

Navigation Light Bulbs

10,000 feet of Sensor Cable

20 Connectors - Sea Con XSL-8-CCP molded to 18" pigtails

1 Spare Sensor and Mount for Each In-Water Sensor

1 Anemometer

1 Barometer

1 Foghorn and Light

2.6 RECOMMENDED SPARES

1 Transmitter and Timing Logic Unit

1 PCM/Interconnection Unit

100 ST-22 Batteries

1 Transmitter/Receiver Antenna

1 Conic Receiver

Navigation Light Bulbs

10,000 Feet of Sensor Cable

20 Connectors - Sea Con XSL-8-CCP molded to 18" pigtails

1 Anemometer

1 Barometer

1 Foghorn and Light

7 C-T Sensors and Mounts

2 Current Meters and Mounts

2 Flow Meters and Mounts

D-Pad Spare Circuit Boards

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER
NORDA Technical Note 110

2. GOVT ACCESSION NO.
AD-A103550

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)
The Brine Measurement System (BRIMS)
Section III: Operation and Maintenance Manual

5. TYPE OF REPORT & PERIOD COVERED

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
Alexander L. Sutherland
Robert A. Brown
Ronald T. Miles
Robert L. Williams

8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Naval Ocean Research & Development Activity
Ocean Science & Technology Laboratory, Code 350
NSTL Station, Mississippi 39529

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS
Same as above

12. REPORT DATE
June 1981

13. NUMBER OF PAGES

14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)

15. SECURITY CLASS. (of this report)
UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)
Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
Ocean measurement system
Brine dispersion
Oil storage

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A unique ocean measurement system that measures and analyzes highly saline brine pumped out from a salt dome, which is used for oil storage, has been developed and installed by the Naval Ocean Research and Development Activity under Department of Energy and National Oceanic and Atmospheric Administration sponsorship. Called the Brine Measurement System or BRIMS, the system monitors the dispersion of brine in the sea as it is evacuated

(CONTINUED)

from the Bryan Mound salt dome near Freeport, Texas, through a three-foot-diameter pipeline extending 12.5 miles offshore.

BRIMS has been designed to be a remote multi-sensor ocean measurement sytem that can provide real time data from a variety of bottom-laid and above-water sensors.

This paper addresses the operations and maintenance requirements necessary to the continuing utilization of the BRIMS.

DAT
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